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May 21, 1992

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Ms. Donna Searcy  
Secretary  
Federal Communications Commission  
1919 M Street, N.W.  
Washington, D.C. 20554

Re: Petition of American Personal Communications

Dear Ms. Searcy:

Enclosed for filing please find 15 copies of a "Further Supplement to Petition for Rule Making" by American Personal Communications. An original and four copies are for filing with the rule making petition. A second original and four copies are for filing in General Docket No. 90-314. The five additional copies are for distribution to the Commissioners. Any questions regarding this matter may be addressed to the undersigned.

Sincerely,



Martin Wald

Attorney for American  
Personal Communications

MW:bat

Enclosures

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Before the  
FEDERAL COMMUNICATIONS COMMISSION  
Washington, D.C. 20554

MAY 21 1992

In the Matter of Petition of	)	Federal Communications Commission
	)	Office of the Secretary
AMERICAN PERSONAL COMMUNICATIONS	)	RM- _____
For Amendment of the Commission's Rules	)	
to Allocate spectrum for Provision of	)	Gen. Docket
Personal Communications Services ("PCS")	)	90-314
and PCS Microwave, and to Create a New	)	
Subpart of the Commission's Rules to	)	
Authorize PCS As a New Service	)	

To: The Commission

FURTHER SUPPLEMENT TO PETITION FOR RULE MAKING

On May 4, 1992, American Personal Communications ("APC") filed a supplement to its Petition for Rule Making and Proposed Rules concerning Personal Communications Services ("PCS"). The Supplement discussed, among other subjects, the appropriate number of PCS firms to be licensed in each market.

As part of its efforts to develop PCS in the United States, APC commissioned Lexecon Inc. to analyze the economic considerations relevant to the FCC's determination of the number of PCS licensees per market. The analysis was prepared by Lexecon under the direction of Dennis Carlton, executive vice president of Lexecon, who is also a professor of economics at the University of Chicago and a co-editor of the Journal of Law and Economics.

The analysis concluded that, within the constraints of the FCC's licensing practices, promotion of public welfare requires the FCC to balance the cost savings and efficiency gains that would result from licensing a small number of firms against the gains in price competition that would result from


licensing a larger number of firms. The nature of PCS networks suggests that licensing a small number of firms would result in significant scale and spectrum economies. The analysis further suggests that only a limited number of firms would be required to generate the lion's share of competition because prices of PCS could be constrained by competition from suppliers of cellular and other telecommunications services as well as from other PCS operators.

APC's position continues to be that, taking into account existing market forces, other economic factors and spectrum-sharing requirements, the FCC initially should license no more than two common-carrier PCS systems per market. The Commission could, in addition, provide (possibly by establishing a reserve) for an additional license at a later date if warranted by competitive conditions and considering other possible needs for the spectrum.

A copy of the Lexecon study is submitted herewith in connection with APC's Petition for Rule Making, and the Commission's PCS proceeding in General Docket No. 90-314.

Respectfully submitted,

AMERICAN PERSONAL COMMUNICATIONS

By:   
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May 21, 1992

Its Attorneys

**ECONOMIC CONSIDERATIONS IN DETERMINING  
THE NUMBER OF PCN LICENSEES PER MARKET**

**Lexecon Inc.  
May 20, 1992**

We have been asked by counsel for American Personal Communications to analyze economic factors relevant to the FCC's determination of the number of personal communications networks (PCNs) to license in various areas throughout the U.S. Given the assumptions discussed below, promoting society's welfare requires that the FCC balance two principal factors in its decision making process: (i) cost savings resulting from consolidating output in a few firms, each with a broad allocation of spectrum; and abstracting from cost effects, (ii) gains in price competition from more market participants. This memorandum discusses how each of these factors may be affected by issuing different numbers of PCN licenses.

In unregulated markets, competitive forces ultimately determine the number of firms that participate in an industry. This process is not commonly used to determine the number of firms in regulated industries where activity restrictions predominate and where authorization to enter must frequently be obtained before a firm can offer service. Even though under most circumstances economists prefer allowing markets to allocate resources, there remain industries that are not organized in this way.

However much we may applaud the benefits of unfettered competition generally, competition has not typically been used to allocate the electro-magnetic spectrum across alternative uses or in licensing a dedicated portion of spectrum

among firms. We understand that the FCC lacks the legal authority to allocate or license spectrum through auctions or other market mechanisms. In this report we simply assume (and we understand this to be a reasonable assumption) that the FCC will not rely on market forces in assigning the PCS spectrum and will rely instead on lotteries of qualified applicants or comparative hearings. Although Lexecon does not endorse this policy, we take it as given for our analysis and do not consider possible alternative FCC allocation methods.

This memorandum is also based on the assumption that competing PCNs will operate as fully autonomous competing firms that are not allowed to combine or share their network facilities or licensed spectrum. However, the likely existence of scale economies in providing these services suggests that it may be sensible to consider the sharing of spectrum and/or the sharing of a single network facility owned or used by multiple service providers. These possibilities are not considered in our analysis because we understand that the FCC will likely choose to license autonomous firms. Accordingly, we consider the potential effect of licensing additional PCNs in the context of an industry of autonomous firms that share neither common facilities nor spectrum.

We provide no empirical estimates of the costs and benefits from increasing the number of PCN firms operating in an area. Accordingly, our analysis can reach no

definitive conclusion about the appropriate number of PCNs to license in any given area. Nonetheless, many of the factors we consider suggest that desirable industry conditions could result from initially licensing only a limited number of PCNs with sufficient spectrum to enable realization of significant scale and spectrum economies and network efficiencies. Even with only a limited number of PCNs, prices could be constrained by competition between PCN operators as well as from current suppliers of cellular services, paging services and other telecommunications firms. So, for example, the granting of two PCN licenses should not necessarily be viewed as creating a duopoly but rather may be more appropriately viewed as increasing the number of mobile telecommunications providers from (at least) the two that now exist to (at least) four.

Licensing a large number of firms would not necessarily result in a large number of operating networks. If sufficient spectrum is not allocated to each licensee, many or all could choose not to construct systems or would seek FCC permission to consolidate with others before building a network. This process could delay the development of PCNs. The failure to foster the development of efficient PCNs will benefit existing telecommunications firms, such as cellular providers, by insulating them from competitive pressures.

It is not at all clear that the entire PCN spectrum should be licensed immediately. The FCC might prudently choose initially to license a limited number of firms while

holding a portion of spectrum in reserve, to be issued in the future if demand and supply conditions so warrant.

This memorandum is organized as follows: Section I summarizes our understanding of the production technology of PCNs and discusses why increases in the number of operating networks could, under certain circumstances, be expected to raise average industry costs. Section II shows that consumer gains from increased price competition could diminish rapidly as the number of competitors increase. Section III analyses the potential costs to consumers if the FCC licenses "too many" PCN operators and compares these costs to those from issuing "too few" licenses. Section IV shows that the early U.K. experience suggests the importance of scale economies and that the licensing of too many firms may delay the development of personal communications services.

#### I. ECONOMIC EFFICIENCY COULD BE SACRIFICED WITH THE OPERATION OF ADDITIONAL PCNS

There are several aspects of PCN technology which imply that the average cost of providing services could increase as the number of operating PCNs increases. While we do not estimate the magnitude of these cost increases, the possibility of efficiency losses must be considered in determining the appropriate number of licenses to issue as long as scarce spectrum and the lack of a market in spectrum allocation limit entry. For the purposes of the following discussion we assume that PCNs operate independently. We assume, for example, that PCNs will not share physical facilities

and that calls will not be transferred across networks at peak times. It is important to recognize that the basic economics of production discussed below may change if the assumptions of our analysis change.

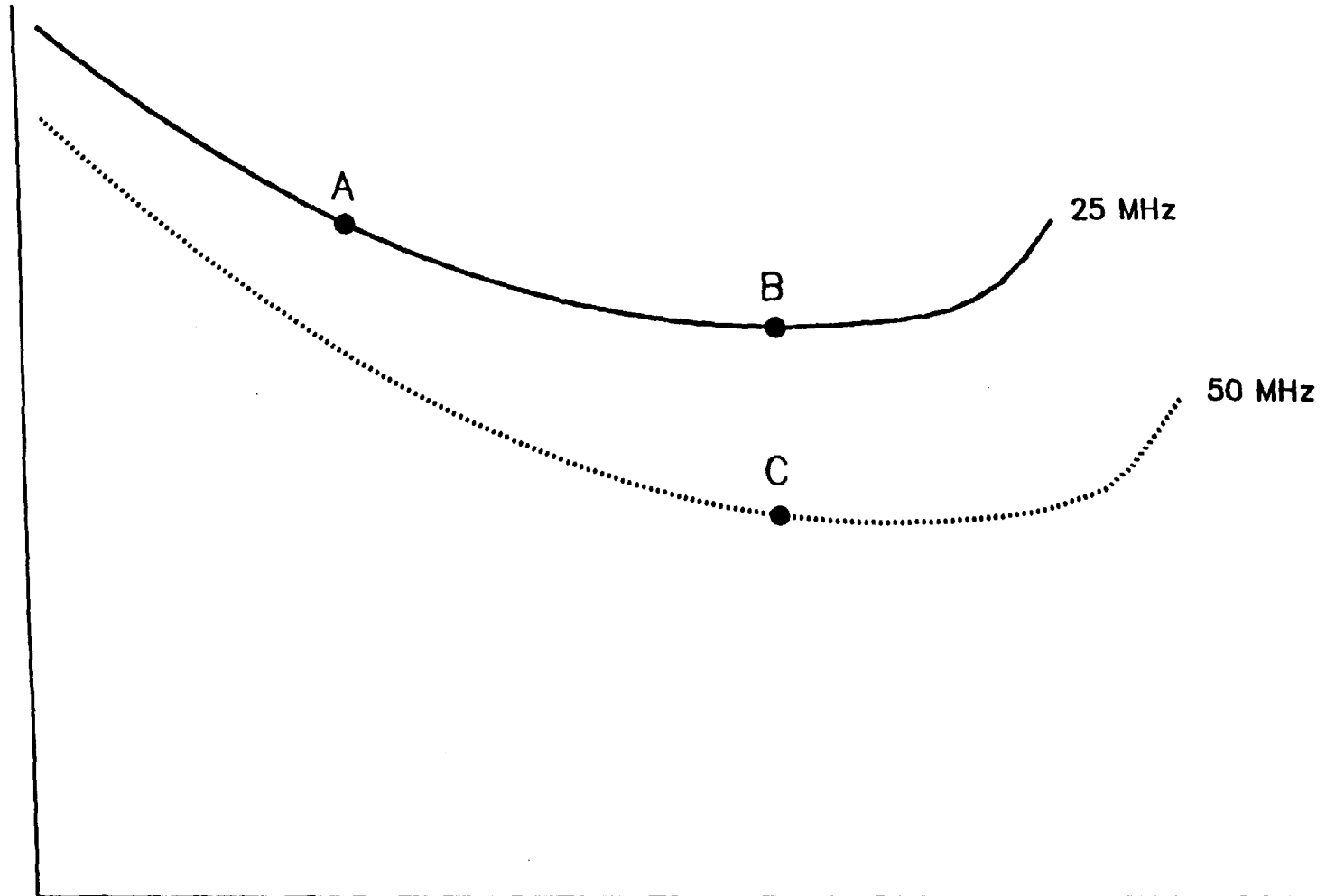
Scale Economies: We understand that the provision of personal communication services is likely to be characterized by significant scale economies. That is, for a given spectrum allocation and quality of service, the average cost of providing service declines as the number of subscribers expands over a broad range of output. There is a low marginal cost of serving additional PCN subscribers over a broad range of output, but a high fixed cost of establishing a network. We understand that the fixed costs of PCNs are expected to be higher than those for current cellular networks due to the smaller areas covered by each cell and the larger number of cells required to provide service in an area. As portrayed in Figure 1, the realization of scale economies is represented by the movement down an average cost curve from points A to B.

"Broad Spectrum" Economies: The cost of providing PCN services to a given number of subscribers depends on the amount of spectrum allocated to a licensee. We understand, for example, that a firm with a license to utilize 50 MHz can provide services to a given number of subscribers at lower cost than a firm with 25 MHz. The higher costs from operating along a narrower spectrum result from the need to reuse allocated frequencies more intensively, which requires

Figure 1

# Hypothetical Average Cost Curves for PCNs Based on Alternative Spectrum Allocations

Average Cost



Number of  
Subscribers

constructing additional "cells" and adopting "cell splitting" technologies. The realization of broad-spectrum economies is represented by the movement from a higher to a lower average cost curve, such as from point B to point C in Figure 1.

Network Inefficiencies: We understand that the effective capacity of the PCN spectrum also declines as the number of PCN operators increases. This inefficiency is a consequence of the random nature of demand for telecommunications systems and is one reason for scale economies. While demands on PCNs are somewhat random, depending, for example, on the precise moment that subscribers place calls, the aggregate demand facing a firm becomes more predictable relative to capacity as a given subscriber base is concentrated among fewer firms. This is a simple consequence of the statistical "law of large numbers." The increased variability in demand resulting from dividing the subscriber base among more firms increases the number of customers who will fail to access the system at peak periods. Alternatively stated, the aggregate number of customers that all firms can support (with a given rate of network access failures) falls as the the number of firms increases.

Each of these aspects of PCN production technology, if true, suggests that increases in the number of operating PCNs increase the overall cost of providing PCN services.

## II. SIGNIFICANT PRICE COMPETITION MAY BE ACHIEVED WITH A LIMITED NUMBER OF PCN OPERATORS

Against the backdrop of efficiencies that can be realized by licensing a limited number of PCNs, the FCC must consider any potentially beneficial competitive effects of licensing additional PCN operators. While we do not quantify these benefits, our analysis suggests that it is possible that only a limited number of licensees are required to generate the lion's share of the benefits of competition.

### A. COMPETITION FROM OTHER TELECOMMUNICATIONS PROVIDERS

PCNs will likely face direct competition not only from other PCNs but also from a variety of other telecommunication providers. Competitors include current providers of cellular mobile services, paging services, specialized mobile radio (SMR) services and the wire telephone network. While not all such firms provide direct competition for each personal communication service PCNs may offer, it is not appropriate to evaluate PCN competition in terms of the number of licensed PCNs alone. Instead, the effect of additional licensees must be evaluated in terms of their incremental effect relative to the current number of service providers. We consider the prevalence of competitive alternatives on a service-by-service basis:

Mobile Communications: PCNs will likely face direct competition from well-established providers of cellular mobile services. In virtually each area of the U.S., two

competing cellular networks have already been in place for as long as 10 years. Additional cellular service networks are now being constructed on the SMR spectrum in six large U.S. cities -- Los Angeles, Chicago, New York, San Francisco, Dallas and Houston. These systems, being constructed by FleetCall, promise to encompass virtually all the services available on "traditional" cellular systems.<sup>1</sup> If successful, similar services are likely to be developed in other areas. Therefore, there are already (or are expected to be) two or three providers of mobile telecommunication services that could be directly competitive with PCNs.

Telepoint: This PCS service permits outbound calling from personal handsets in limited geographic areas such as airports, hotels and train stations, etc. Enhanced telepoint services incorporate a paging receiver in the handset, among other features. These services face competition from pay-telephones and paging services, as well as cellular providers. Each of these services is obviously well-established throughout the U.S. Telepoint services were introduced in the U.K. by three licensees in 1990 and each has since been withdrawn from the market. This experience suggests that it is unlikely that even a sole provider of Telepoint would be able to exploit market power in providing such services.

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1. FleetCall Prospectus, Jan. 26, 1992.

Wireless Private Branch Exchange: This refers to a network of wireless phones for use in an office or campus environment. Small, lightweight handsets would not be tied to fixed locations but could be carried continuously by users. These services will likely compete directly with traditional PBX services already provided by a large number of telecommunications equipment manufacturers, as well as with wire carriers through Centrex-type services.

More generally, exploitation of "microcell" technology and the corresponding ability to target services in limited geographic areas, such as buildings, is not a unique capability of PCN technology:

- Wireless PBX services are already being tested using cellular frequencies by Southwestern Bell. The system uses low-power transmission in the office environment and switches to a conventional cellular mode in outside areas. McCaw Cellular is also developing comparable wireless PBX services on cellular frequencies.<sup>2</sup>
- Bell Atlantic is installing up to 60 microcells in its Washington/Baltimore and Philadelphia cellular systems. These cells provide improved wireless coverage in airports, convention centers, hotels, etc.<sup>3</sup>

Personal Communications Services are also being developed by a wide variety of other telecommunications providers:

- Bell Atlantic is testing in Pittsburgh a personal phone number system that will deliver calls to whatever location the subscriber specifies, including a cellular phone. The system utilizes Bell Atlantic's local cellular network in conjunction with the local wire

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2. Telocator Bulletin, December 27, 1991, pg. 3.

3. Microcell Report, March 1992, pg. 10.

network.<sup>4</sup> Bell Atlantic is offering a similar "one-number" personal communication service in the Baltimore/Washington area that utilizes existing cellular technology.<sup>5</sup>

- AT&T recently announced a personal phone number system that operates on the wire network. This system directs a subscriber's call to a phone number identified by the subscriber. Callers can reach the subscriber at any location by dialing a permanent "person-specific" phone number as opposed to a traditional "location-specific" number.<sup>6</sup>
- Bell South is conducting a market test of portable limited-range, two-way calling services within the Orlando, Fla., metropolitan area. They are also testing an alternative portable two-way calling service restricted to operate within a particular cell site as well as a Telepoint-type service. These services all utilize conventional cellular frequencies and technology.<sup>7</sup>
- Providers of paging services are offering a variety of enhanced services that closely resemble potential PCN offerings. For example, many paging services already offer one-way voice communication; two-way paging (allowing acknowledgement that the page has been received); voice-mail services; text transmission; and multiple message storage. Paging firms also have proposed more elaborate service offerings including single-number services that allow subscribers to route calls to telephones, messaging services or paging services.<sup>8</sup>

This brief review suggests that virtually all of the services that PCNs promise to offer can also be provided by other telecommunications firms. Therefore, it may be more

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4. Telocator Bulletin, February 14, 1992, pg. 5.
  5. Microcell Report, April 1992, pg. 10.
  6. New York Times, April 29, 1992, pg. A-1.
  7. Telocator Bulletin, November 15, 1991, pg. 4-5.
  8. Form 10K filed by Page America Group with Securities and Exchange Commission for fiscal year ending December 31, 1991.

realistic to regard the granting of, perhaps, two PCN licenses as increasing the number of mobile telecommunications providers, from two (or three, where SMR exists) to four (or five) rather than as the creation of a duopoly.

B. EVIDENCE FROM OTHER INDUSTRIES SUGGESTS THAT INCREMENTAL FIRMS HAVE A DECLINING MARGINAL EFFECT ON PRICE

There is little direct evidence on the marginal impact on competition resulting from increasing the number of telecommunications suppliers from one to two to three, etc.<sup>9</sup> This is due to the continuing role of regulation and the small number of providers of many telecommunications services. Nevertheless, this question has been examined with respect to pricing in other industries.<sup>10</sup>

This literature indicates, not surprisingly, that increasing the number of competitors from one to two yields significant declines in price. Further increases in the number of competitors tend to lower price but at a much diminished rate. For the industries studied by Brannman, et. al., only the first four to nine competitors

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9. For an exception see, T.W. Hazlett, "Duopolistic Competition in Cable Television: Implications for Public Policy," 7 Yale J. Regulation 65 (1990). Hazlett finds that consumers in areas in which two cable-television operators are franchised pay significantly lower prices than those in "monopoly" areas.
10. L. Brannman, J. Klein, and L. Weiss, "The Price Effects of Increased Competition in Auction Markets," in L. Weiss, ed., Concentration and Price (1989), pg. 67.

systematically affect price. (See Table 1.) The addition of a second competitor, however, typically has the greatest effect on price. In four of the six cases studied by these authors, more than half of the total impact on price is accounted for by the second competitor alone.

C. FIRMS OFTEN CHOOSE TO DEAL WITH A LIMITED NUMBER OF SUPPLIERS OR DISTRIBUTORS

Although it is often assumed that a large number of firms is required to ensure competition, there is no necessary relationship between the number of participants and competition. Firms often choose to deal with a limited number of licensees, suppliers or distributors. While this may seem paradoxical because the firm appears to deny itself the benefits of competition, such behavior is generally undertaken because dealing with one or a limited number of firms is more efficient than dealing with many. This provides direct evidence that it is often sensible to limit the number of suppliers in the presence of scale economies.

Public Goods: Often the nature of technology dictates that a single firm performs a function at lower cost than multiple firms. Stevens, for example, studied municipal garbage collection services, comparing firms that permit competing services with those that provide them through

Table 1

Price Effects of Additional Competitive Bidders

Product	Number of Competitors That Systematically Affect Price	Percentage of Total Price Change Achieved By Addition of the Second Firm
Bond Underwriting		
General Obligation	9	52.2%
Revenue	7	61.6
Offshore Oil Tracts		
1954 - 1971	8	21.8
1972 - 1975	4	53.4
Timber Acreage		
Sealed Bids	3	58.5
Oral Bids	4	28.9

Source: Lance Brannman, J. Douglass Klein, & Leonard W. Weiss, "The Price Effects of Increased Competition in Auction Markets," in Leonard W. Weiss, ed., Concentration and Price, p.73 (1989).

either public or private monopolies.<sup>11</sup> She finds that the competitive arrangement is 25 to 50 percent more costly than the private monopoly. In these circumstances, economic efficiency dictates that only one firm serve the market.

Defense Procurement: The procurement process for the military provides another example in which dealing with a limited number of suppliers often enhances efficiency. The potential efficiency of limiting the number of competing firms is seen both in (i) inviting a limited number of firms to compete in the design phase of a project; and (ii) awarding the production contract to one firm (or consortium).

Rogerson summarizes this process:

"In a typical aerospace project the Department of Defense sponsors a design competition in which two or more firms are funded to independently produce competing proposals....The winning firm goes on to build or adapt a production line and becomes the sole prime contractor for the program. Economies of scale together with very small production runs render it economically infeasible to have two or more firms build fully functional production lines."<sup>12</sup>

This procedure recognizes that the participation of a large number of firms in the design stage typically does not yield competitive benefits that exceed the cost of eliciting such bids. At the production stage, the selection of a

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11. Barbara Stevens, "Scale, Market Structure and The Cost of Refuse Collection," 60 Review of Economics and Statistics 438 (1978).
  12. W.P. Rogerson, "Profit Regulation of Defense Contractors and Prizes for Innovation," 97 J Pol. Econ. 1285 (1989).

single contractor allows realization of scale economies and benefits from experience from the design stage. Price competition at this stage is often introduced by second source requirements. This competitive check, however, is typically achieved by introducing just one second-source into the process.<sup>13</sup>

### III. ASYMMETRY IN THE CONSEQUENCES OF ERRORS IN THE LICENSING PROCESS

Typically, market forces determine the number of firms that will survive in an industry. If "too many" firms enter an industry, some fail. If "too few" enter, more follow. If the FCC licenses "too many" PCN operators, all licensees may have an inefficiently narrow spectrum and may choose not to construct systems, or will otherwise delay system construction. It may be difficult for the FCC to rectify this error quickly. On the other hand, the costs of licensing "too few" PCN operators can be rectified by the FCC by licensing additional spectrum initially held in reserve (or by reallocating spectrum reserved for alternative uses if additional suppliers wish to enter).

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13. J.J. Anton and D.A. Yao, "Second Sourcing and the Experience Curve: Price Competition in Defense Procurement," 18 Rand J. Econ. 57 (1987).

A. THE COSTS OF ISSUING "TOO MANY" LICENSES

Consumers could be harmed if the FCC issues more licenses than the number of PCNs the market can efficiently support. If the FCC issues an inefficiently large number of licenses to operate PCNs in a given area, the spectrum made available to any licensee will be limited and firms may not be able to take advantage of economies of broad-spectrum operation. In the face of inefficiently large fixed costs, competition from suppliers of closely-related telecommunications services and uncertain future demand, many licensees may choose simply not to construct systems. In this way, issuance of "too many" licenses could inhibit the provision of PCN services.

The ability of licensees to "undo" any such error by the FCC by consolidating licenses may be limited because, we understand, the FCC typically restricts the resale or consolidation of licenses. Of course, if development of PCNs is inhibited over an extended period, it seems likely that the FCC would eventually permit such actions. In this circumstance, however, consumers could still be harmed by the delay in the provision of efficient services.<sup>14</sup>

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14. Even if the FCC were to freely permit resale and consolidation of licenses, the consolidation process itself may take time. The development of cellular telecommunications services in the SMR spectrum provides an example of this: FleetCall initially started accumulating SMR licenses in 1988; it now expects to begin offering services in 1993-95.

**B. THE COSTS OF ISSUING "TOO FEW" LICENSES**

If the FCC licenses fewer firms than can be efficiently sustained, consumers may be harmed to the extent that prices would be too high. There are several possible direct remedies to such a situation. First, the FCC could choose initially to issue a limited number of licenses (each allowing sufficient spectrum for efficient provision of services) while holding a portion of the PCS spectrum in reserve. This reserve could then be licensed to other firms if future industry conditions so warranted. Alternatively, additional spectrum could be allocated to PCS from other parts of the spectrum if future conditions so warrant.

In sum, issuance of "too many" licenses could inhibit or delay the development of PCN technology. This protects the existing service providers from competition and harms consumers. Issuance of "too few" licenses can be directly rectified by issuing additional licenses. The asymmetry in the costs of such errors favors issuing a smaller rather than a larger number of PCN licenses.

**IV. LESSONS FROM THE U.K. EXPERIENCE**

The U.K. was the first nation to license personal communication services. In January 1989, licenses were awarded to four companies to provide Telepoint services, which enable subscribers to make outgoing calls only from portable phones in specially designated areas. In December

1989, licenses were awarded to three firms to provide PCNs, which eventually are to provide ubiquitous two-way calling services throughout the U.K.<sup>15</sup>

The brief history of these services in the U.K. suggests that personal communications services face competition from other telecommunications services. The U.K. experience also provides direct evidence regarding the importance of scale economies.

Telepoint: These services were introduced by three of the four licensees between August and December of 1989.<sup>16</sup> Each licensee ceased providing service by September 1991. The fourth licensee has not yet launched service. The failure to date of U.K. Telepoint systems is attributed primarily to a simple lack of interest by consumers.<sup>17</sup> Basically, Telepoint seems to have attempted to serve a market niche that simply was too small to support such a service. Services were priced well above pay phones, which provided a ready substitute in areas in which Telepoint operated.

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15. Both Telepoint and PCN licenses enable service providers to operate throughout the U.K.
  16. The licensees were owned by large firms with extensive telecommunications experience: Phonepoint was owned by British Telecom, STC, Nynex, Bundespost and France Telecom; Zonephone was owned by Ferranti, Cable and Wireless and others; Callpoint was owned by Mercury, Shaye and Motorola. The remaining licensee that is yet to introduce service is 4-BYPS which was owned by Philips, Barclays and Shell.
  17. See: Saadet Toker, Mobile Communications in the 1990's: Opportunities & Pitfalls, London Business School, Centre for Business Strategy, 1992.

These problems may have been exacerbated by confusion on technical standards: there was concern that some handsets may become obsolete when deadlines for intersystem roaming would have become effective in mid-1991.

PCNs: Three consortia were granted national PCS licenses in 1989: Mercury, Microtel and Unitel.<sup>18</sup> There has since been considerable turnover in the ownership of these firms. The most recent and significant change is the merger in March 1992 between Mercury and Unitel.<sup>19</sup> The merged firm will operate under one license; the other license will be revoked.<sup>20</sup> As a result, there are now only two PCNs licensed in the U.K. neither of which is yet in operation. At present, the remaining portion of the spectrum dedicated to PCNs remains unlicensed. Mercury and Unitel had previously planned to utilize a parallel network architecture which would have allowed the firms to share many basic network facilities.

The Mercury/Unitel merger and forfeit of spectrum suggest the current market for telecommunication services in

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18. Mercury was originally owned by Cable & Wireless, Motorola and Telefonica; Microtel was initially owned by British Aerospace, Pacific Telesis, Millicom, Matra Communications and Sony; and Unitel was originally owned by Thorne EMI, US West, and Deutsche Bundespost Telekom.
  19. Mercury/Unitel is owned by Cable & Wireless and U.S. West. Microtel is owned by Hutchinson Telecom.
  20. Mobile Phone News, April 9, 1992, pg. 3, and discussion with the Telecommunications and Ports Division of the Department of Trade and Industry.

the U.K. is unlikely initially to support more than two PCN operators. The merger will permit the realization of scale economies (as opposed to broad spectrum economies) because the merged firm will operate with the same amount of spectrum previously allocated to only one firm. More specifically, the action indicates that abandoned spectrum has less value -- in terms of allowing the firms to serve future demand or in terms of excluding another potential PCN entrant -- than the cost savings that can be realized by consolidating operations.

The initial licensing of three firms may have also delayed introduction of PCS relative to the initial licensing of two firms. The merger, for example, made prior research into parallel network architecture irrelevant.<sup>21</sup> PCN licensees initially had projected territorial coverage of 45 percent of the U.K. by 1992; Mercury/Unitel now hopes to begin offering services in 1993.<sup>22</sup>

#### CONCLUSION

Based on certain assumptions regarding PCN technology and the manner in which the FCC intends to allocate licenses, our analysis suggests that decisions regarding the number of PCN licenses to issue must balance: (i) possible efficiency losses resulting from additional licenses; and

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21. PCS News, April 2, 1992, pg. 1.

22. Microcell Report, April 1992, pg. 4.